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TESTING DEVICE FOR VEHICLE CRASH SIMULATION

Inventors:	Christian Bietwer 65510 Idstein, DE Josef Beran 64380 Roßdorf, DE
Applicant:	Instron Schenck Testing Systems GmbH 64293 Darmstadt, DE
Agent:	H. Behrens Attorney at Law 64293 Darmstadt

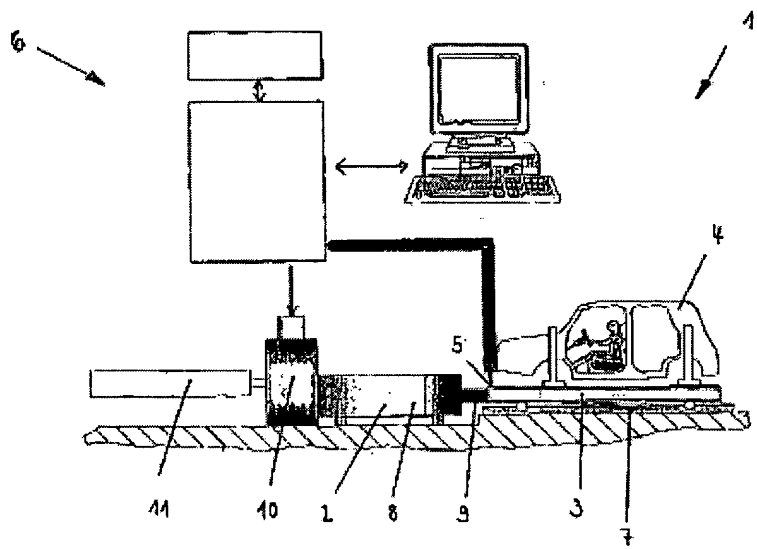
Documents cited for evaluation of patentability:	DE 195 41 318 C2 DE 197 50 157 A1 DE 195 11 422 A1 DE 297 21 927 U1 DE 197 80 550 T1 US 57 83 739 Heuser, Gerd, Diedershagen, Gerd: Crash system for operation in two directions. Published in: ATZ - Automobiltechnische Zeitschrift 100, 1998, 2, pp. 142-150; Müller, Carl-Friedrich et al.: New possibilities for accident simulation

by means of optical
remote-controlled driving of a motor
vehicle. Published in: ATZ -
Automobiltechnische Zeitschrift 100,
1998, 1, pp. 8-13;

The following information was taken from the documents submitted by the Applicant

[Abstract]

A testing device for motor vehicle crash simulation comprises a horizontally arranged carriage arrangement, which moves horizontally along a rail arrangement, a test unit that includes the vehicle components to be tested provided on the carriage arrangement; a first acceleration unit, which a selectable acceleration value can be transferred to the carriage arrangement; and in order to realized improved simulation of accident conditions, a second acceleration unit (17,17',17") with which selectable acceleration values can be transferred to the carriage arrangement (16) in the vertical direction.



This invention pertains to a testing device for motor vehicle crash simulation according to the preamble of Claim 1.

Development times in automotive technology are becoming increasingly shorter, and demands for higher passenger safety have resulted in the development and design of testing devices for crash simulation, which also are called servo-hydraulic catapult systems.

During reverse crash tests, which is the reversal of deceleration to acceleration, vehicle components, such as seats, steering columns and steering wheels, windshields, dashboards, safety

belts and their fixtures, airbag systems, and other components are controlled and accelerated, so that the crash behavior and/or component reliability can be tested on a carriage on a heavy-duty chassis, the so-called armor-plated chassis, according to various accident conditions. In this case, the acceleration is produced by a servo-cylinder acting as a control element. The servo cylinder is controlled by means of a four-level servo-valve, which is connected to a piston memory unit. This type of servo-hydraulic catapult system, for example, is known from the industry journal RIQ, edition 1/1998, pages 2 to 4, published by Mannesmann-Rexroth.

In view of the foregoing, the problem of the present invention to improve the simulation of accidents in a testing device for motor vehicle crash simulation.

The aforementioned problem is solved by the present invention in that accelerations, which are selectable in the vertical direction via a second acceleration unit, are transferable to a carriage arrangement. As a result of initiating the vertical accelerations to the carriage arrangement, the simulation of crash accidents can be improved, since, during a rear-end collision, for example, the rotational motion of the vehicle about the y-axis, i.e., the transverse axis, occurs, and this additional motion of rotational can now be simulated as well due to the additional second acceleration unit. This angle, resulting from a rotation about the y-axis, is referred to as the pitch angle (DIN 70 000).

In an embodiment of the idea of the invention, it is proposed that the second acceleration unit consists of three controllable cylinders, in which the second and third cylinders are selected simultaneously. As a result of this development, the carriage can be pitched randomly about the y-axis. The carriage arrangement can be displaced randomly in the direction of the z-axis.

Additional advantageous characteristic features, as well as the operation of the invention, arise from the following description of an embodiment [and] by means of the drawings.

In the drawings:

Figure 1 shows a prior-art testing device for motor vehicle crash simulation;

Figure 2 shows a side view of the rail and carriage arrangement, as well as a second acceleration unit of the testing device of the invention; and

Figure 3 shows a top view of the arrangement of Figure 2.

Figure 1 shows a schematic diagram of a prior art servo-hydraulic catapult system and/or testing device 1 for simulating crash accidents.

The testing device 1 essentially consists of an acceleration unit 2, a carriage 3 moving on rails 7, comprising the test unit 4 and measurement and control devices 5, 6. A setpoint value for selecting the acceleration unit, which is modeled via an iteration process, is stored in the control unit.

According to Figure 1, the test unit 4 consists of a heavy-duty chassis comprising vehicle components to be tested, such as seats, steering column, steering wheels, windshields,

dashboards, safety belts and attachments, airbag systems, as well as a dummy. Further, the chassis is permanently connected to a carriage arrangement 3. As explained in the introduction, the prior art testing devices use so-called reverse crash tests, i.e., the decelerations occurring in an actual motor vehicle collision during the forward motion are converted into an acceleration, in which the test unit 4 is moved backwards. During this process, the acceleration is applied by a first acceleration unit 2, which is selected according to the set point value stored in the controlling device.

The first acceleration unit 2 consists of a servo cylinder 8 comprising a horizontally movable piston and a piston rod 9 as control element. Further, the servo cylinder 8 is controlled via a four-level servo-valve 10, which is connected to a piston memory unit 11. The acceleration is performed via the horizontally moveable piston located in the servo cylinder 8, which comprises a piston rod 9 leading towards the outside and transmitted to the carriage arrangement 3. The carriage arrangement 3, comprising the test unit 4, is then accelerated corresponding to the initiated acceleration along the rail arrangement 7, i.e., in a horizontal plane. Thus, the acceleration is measured via corresponding sensors 5 at the carriage arrangement 3 and fed to the control unit 6. The control unit 6 then compares the measured actual acceleration profile against the selected setpoint acceleration profile. In light of a deviation between the actual value and the setpoint value, a new setpoint value is generated. Not shown are the dual-cycle braking system, which is provided at the carriage arrangement 3, as well as the return unit, which returns the carriage arrangement 3 after the test operation to the starting position. Furthermore, the emergency braking system, which is provided at the rail arrangement 7 is also not shown.

High-speed cameras, a lighting unit, as well as additional braking circuits for simulating a lateral impact, may be provided as auxiliary equipment.

Figures 2 and 3 show the rail arrangement 15, as well as the carriage arrangement 16, and a second acceleration unit 17, 17', 17" of the testing device 18 of the invention, which are shown in side and top views, respectively. The coordinate system 19, which appears in Figures 2 and 3, defines the direction of the x-, y-, and the z-axes.

The rails of the rail arrangement 15 run parallel and are located in the horizontal plane defined by the x-axis. The carriage arrangement 16 slides on the rails, which are not shown in detail in the drawings.

The acceleration, which is initiated by the first acceleration unit according to a selected setpoint value in the carriage arrangement 16 on the rails is effected via a piston rod 21 of the cylinder acting in the direction of the arrow 20, i.e., in the direction of the x-axis as defined in the drawings. The first acceleration unit corresponds to the acceleration unit already described in connection with Figure 1, and is thus indicated for the sake of simplicity in Figure 2 and 3 only in the form of a piston rod 21.

The carriage arrangement 16 essentially consists of a rectangular plate 22 as well as a second plate 23, which are separated in parallel with respect to the z-axis. A test unit is fixed on the second plate 23, which is already described in detail in Figure 1. The support and seating of the second plate 23 is effected via a second acceleration unit 17, 17', 17", which, in the embodiment shown consists of three cylinders, which are provided orthogonally, i.e., aligned in the direction of the z-axis, with the first cylinder 17 centered on the first plate 22 in the front-end section, as viewed in the direction of acceleration. The piston rod 24 of the first cylinder 17, which extends toward the outside, is provided via a pivot joint 25, which also is centered in the front-end section of the second plate 23 and can be connected to the second plate 23. The seating allows a rotation about the y-axis and displacement of the piston rod 24 in the direction of the z-axis.

The second and third cylinders 17', 17" are provided on a base 27 and separated in relation to a center line 26 of the first and second plate in direction of the x-axis. The two cylinders 17', 17" are fixed to the base 27 so that vertical and upward extending piston rods 24', 24" of the second and third cylinders, which extend toward the outside, i.e., pointing in the direction of the z-axis, respectively, are seated in lateral guide rails 28, which are aligned in the x-direction at a second plate 23 in the rear section of the plate. The seating is a pivot joint 29 and allows both translations along the guide rails 28 and a rotation of the piston rod ends 24', 24" in relation to the guide rails 28.

During the test procedure for crash simulation, first an acceleration is transferred according to the selected setpoint value to the front of the first plate 22 via the schematically shown piston rod 21 of the cylinder of the first acceleration unit, so that the carriage arrangement 16, i.e., the first and second plate, plus test unit, can be moved in translation along the rails 15, i.e., in the direction of the x-axis.

In addition to the acceleration initiated in the direction of the x-axis, three cylinders 17, 17', 17" can be selected, so that the accelerations in the direction of the z-axis can be initiated via the piston rods 24, 24', 24" and the corresponding seatings 25, 29, which are provided at the second plate 23. As a result, in particular, a so-called pitching motion of the vehicle that occurs during an actual collision can be achieved, i.e., a rotational motion of the vehicle about the y-axis can be simulated during a test operation, which is effected by simultaneously controlling the second and third cylinders. Depending on the control exercised, i.e., according to a generated selected setpoint value, any complex translatory motion can be initiated in the z-direction, and the torsional motion about the y-axis can be initiated.

In a another embodiment, it is advantageous if all cylinders are movably seated, and the first, second, and third cylinder individually controlled. It is then possible to initiate any complex pitching motion of the second plate 23 about the x-axis and the y-axis.

At the end of the test operation, the piston rods 24', 24" of the second and third cylinders 17', 17", which are seated in lateral guide rails 28, separate from the guide rails 28, the second plate 23 is then held by a safety device 30 (only shown schematically) in the end position.

Claims

1. Testing device for motor vehicle crash simulation, comprising a horizontally provided carriage arrangement, which is horizontally movable along a rail arrangement, a test unit provided on the carriage arrangement, including the vehicle components to be tested, a first acceleration unit, via which a selectable acceleration can be transferred to the carriage arrangement, characterized in that, by means of a second acceleration unit (17,17',17"), selectable accelerations can be transferred to the carriage arrangement (16) in the vertical direction.

2. Testing device for motor vehicle crash simulation of Claim 1, characterized in that the first acceleration unit comprises a selectable servo cylinder, and the second acceleration unit (17,17',17") a first, second and third servo cylinder, in which the second and third servo cylinder are selected simultaneously.

3. Testing device for motor vehicle crash simulation of Claim 2, characterized in that the carriage arrangement (16) consists of a first plate (22) which slides on the rail arrangement (15), and a second plate (23), which is separated from and parallel to the first plate in the vertical direction, and that the acceleration generated by the first acceleration unit is initiated via the first plate (22), and in that the acceleration generated by the second acceleration unit (17,17',17") is transferred to the second plate (23).

4. Testing device for motor vehicle crash simulation of Claim 3, characterized in that the first servo cylinder (17) of the second acceleration unit is centered in the front end section of the first plate (22), in that the vertically upward extending piston rods (24) are centered in the front end section of the second plate (23), in that the second and third servo cylinders (17',17") are provided on base (27), and in that the vertically upward extending piston rods (24',24") are respectively seated at the rear end section of the second plate (23).

5. Testing device for motor vehicle crash simulation of Claim 4, characterized in that seating of the piston rods of the first, second and third cylinders (17,17',17") is effected via pivot joints (25,29).

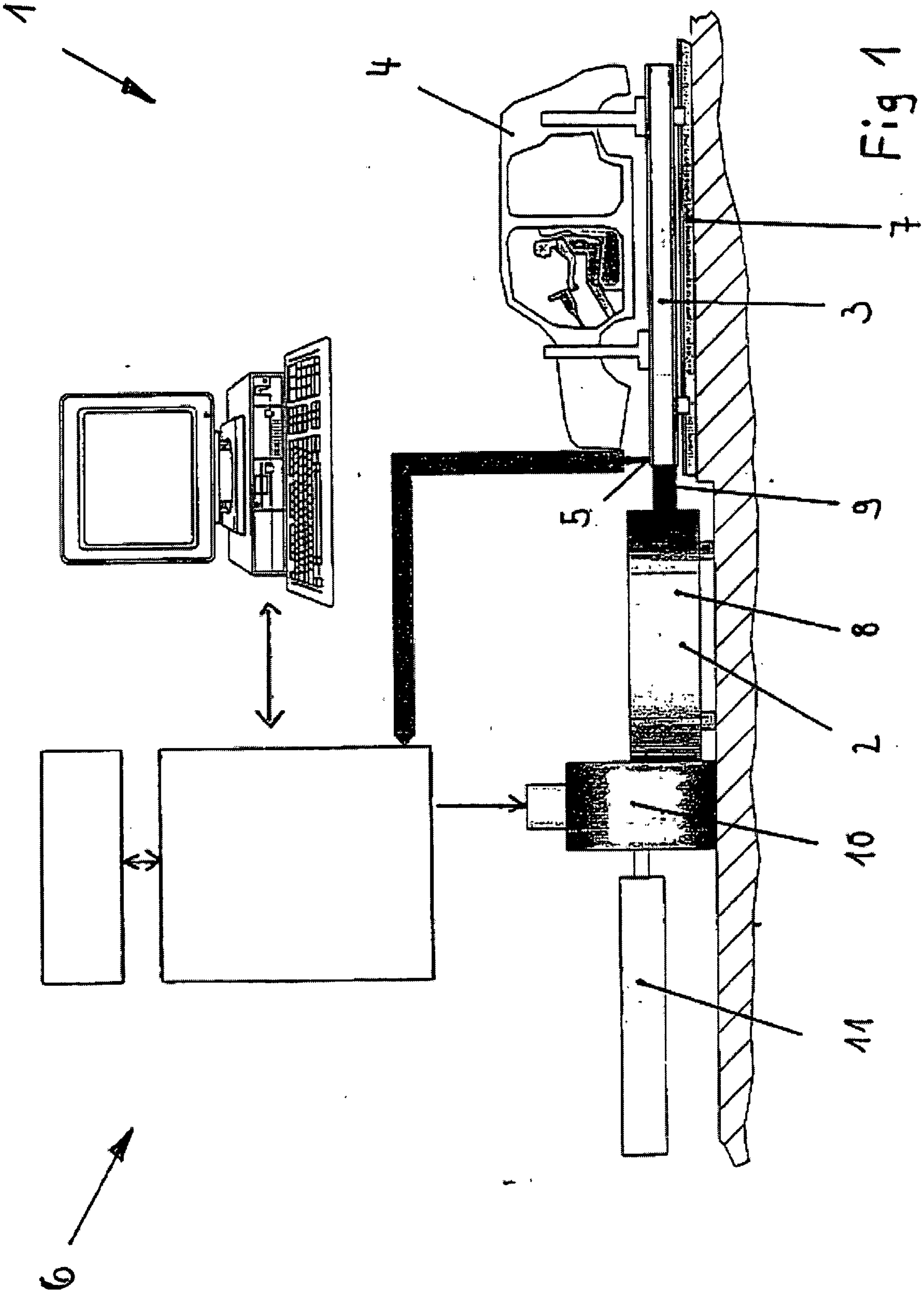
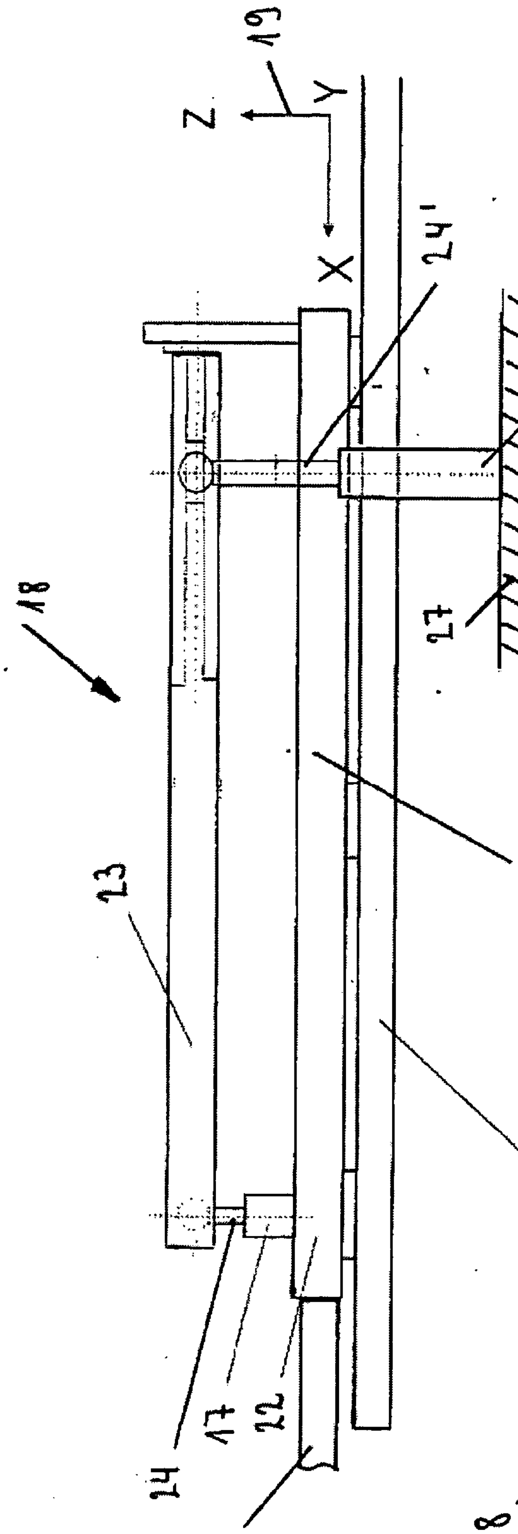
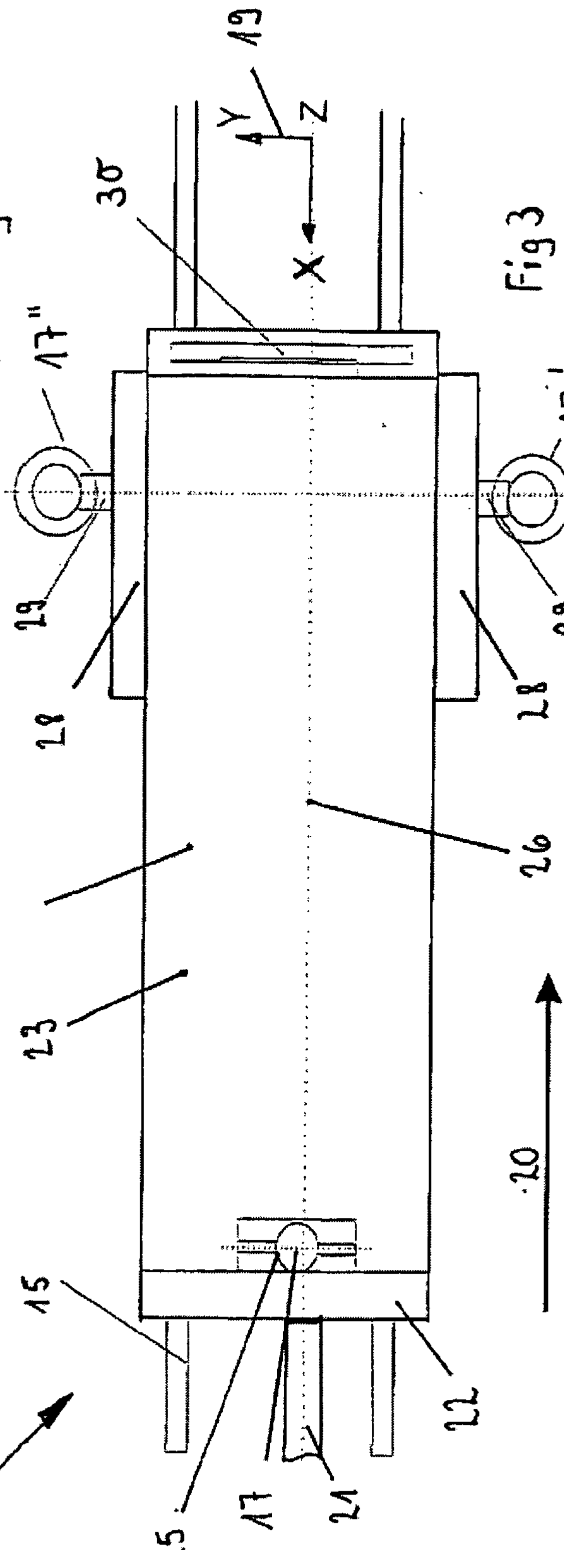


Fig 1



Z
Y
X
19
24'
17''
17'
27
18
16
23
15
14
17
22
21

Fig 2



Y
Z
X
19
30
17''
17'
29
28
26
23
20
15
22
25
17
21
18

Fig 3